


SKILLSHEET 10.2

Graphing exponential functions

Relationships of the form $y = a^x$ are called exponential functions with base a , where a is a real number not equal to 1, and x is the index or exponent. Exponent is another word for index or power. The term *exponential* is used because the independent variable x is the exponent.

Note: In this chapter we will take only positive values of a .

WORKED EXAMPLE 1

Complete the table of values below and use it to plot the graph of $y = 2^x$.

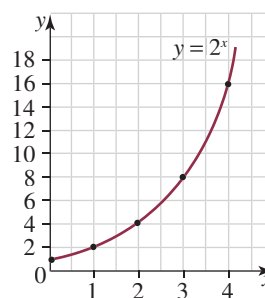
x	0	1	2	3	4
y					

THINK

- 1 Substitute each value of x into the function $y = 2^x$ to obtain the corresponding y -value.
- 2 Plot each point generated on a set of axes.
- 3 Join with a smooth curve.

WRITE

x	0	1	2	3	4
y	1	2	4	8	16



The graph in worked example 1 has several important features.

1. The graph passes through $(0, 1)$. That is, the y -intercept is 1. The graph of any equation in the form $y = a^x$ will pass through this point.
2. The graph passes through the point $(1, 2)$. All graphs of the form $y = a^x$ will pass through the point $(1, a)$.
3. $y > 0$ for all values of x . You will notice that for negative values of x , the graph gets very close to but will never touch the x -axis. When this occurs, the line which the graph approaches is called an *asymptote*. The equation of the asymptote for $y = a^x$ is $y = 0$.

WORKED EXAMPLE 2

- a Plot the graph of $y = 3 \times 2^x$ for $0 \leq x \leq 3$.
- b State the y -intercept.
- c Write the equation of the horizontal asymptote.

THINK

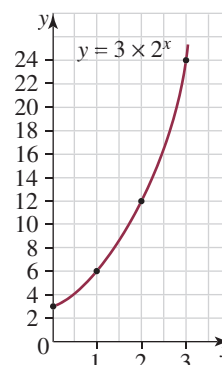
- 1 Prepare a table of values taking x -values from 0 to 3. Fill in the table by substituting each value of x into the given equation.

WRITE

x	0	1	2	3
y	3	6	12	24



- 2 Draw a set of axes on graph paper to plot the points from the table and join them with a smooth curve.



- b** Locate where the curve cuts the y -axis. Alternatively, find the y -value for $x = 0$ in the table.
- c** Find an imaginary line to which the curve gets closer and closer but does not cross. As it is a horizontal asymptote, the equation will be of the form $y = \text{constant}$.
- b** The y -intercept is 3.
- c** The equation of the asymptote is $y = 0$.

Worked example 3 considers the effect of a base that has a value less than 1.

WORKED EXAMPLE 3

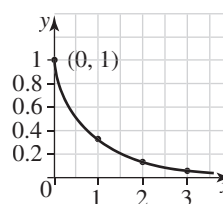
Plot the graph of $y = \left(\frac{1}{3}\right)^x$ for $0 \leq x \leq 3$, clearly showing the y -intercept and the horizontal asymptote.

THINK

- 1 Draw up a table of values.
- 2 Substitute the values of x into the equation to find the corresponding y -values.
- 3 Draw a set of axes, plot the points generated from the table and join with a smooth curve.

WRITE

x	0	1	2	3
y	1	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{27}$



Try these

- 1 Plot the graph of each of the following exponential functions.

a $y = 4^x$ **b** $y = 5^x$ **c** $y = 6^x$
- 2 On the one set of axes, draw the graphs of $y = 2^x$, $y = 3^x$ and $y = 4^x$.
- 3 Complete the table of values below and use the points generated to sketch the graph of $y = \left(\frac{1}{2}\right)^x$.

x	0	1	2	3
y				

- 4 Draw the graph of $y = 10 \times (1.3)^x$.

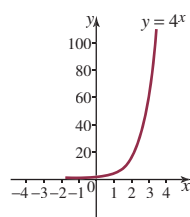


SKILLSHEET — ANSWERS

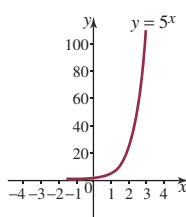
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Graphing exponential functions

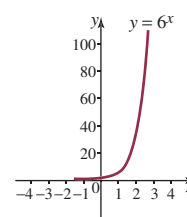
1 a



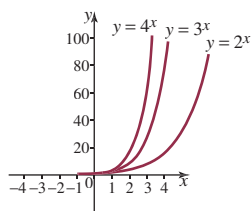
b



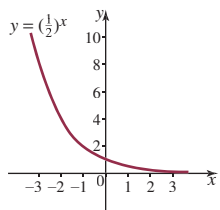
c



2



3



x	0	1	2	3
y	1	0.5	0.25	0.125

4

